

**Xspress 3**

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An SDD and HPGe detector readout
for fluorescence and EXAFS detectors

Technical Datasheet



Many solid-state detectors are not limited by their intrinsic rate capability, but by the readout system connected to them. Xspress 3 was developed to maximize the throughput and resolution of such detectors and remove the bottleneck at the readout stage.

The primary benefit of using Xspress 3 over traditional readout systems is simple: at rates above 100 Kcps (counts per second), for any given resolution the output rate achievable per channel with Xspress 3 is up to 30 times faster than other systems.

This opens up the beamline to much faster data collection. Its extended dynamic range (0 - 3.4 Mcps per channel) can reduce the number of scans required and save large amounts of time with attenuation selection. The higher rate can also lead to less damage to samples, better statistics and ultimately higher beamline throughput and data quality.

In addition to this, because Xspress 3 does not use fixed shaping or peaking times, the system effectively optimizes the output for each sample (or each pixel for mapping applications) without user intervention.

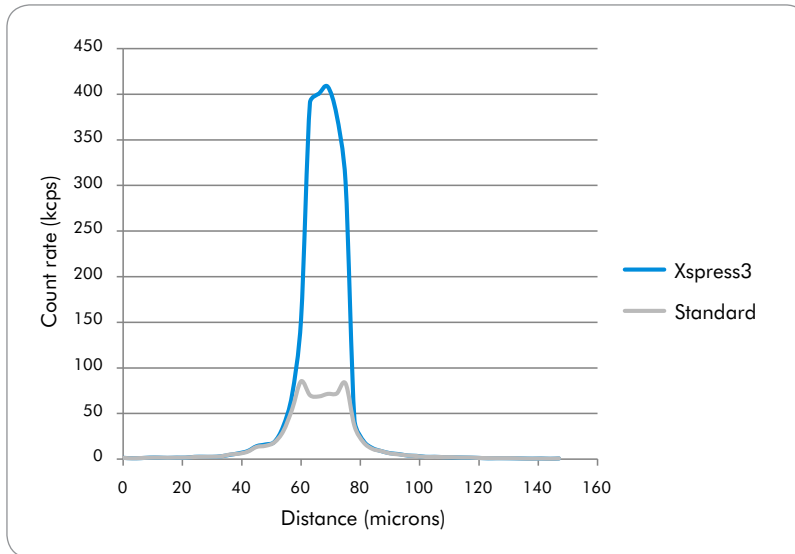
The system can handle up to 8 channels of input per unit and can be synchronized with other Xspress 3 units. Please read on or get in touch for details or answers to your specific questions.

KEY features & benefits

- **Greater than 3.5Mcps output rate**
- **>80ns deadtime per event**
- **Up to 8 channels supported**
- **Out of the box EPICS and TANGO integration**

Output Rate

To give some context for the benefits of this increased scanning rate, imagine a readout system that becomes saturated at 100 kcps, beyond which it becomes paralyzed, leading to a lower output rate with increasing input rate and often unusable resolution. Xspress 3 is able to usefully read out events at up to 35 times that rate, 3.5 million counts per second. An example of this difference is shown below: data were recorded at the SSRL with both the existing readout and Xspress 3 set up in their standard operating modes.



Copper wire scan, 3 micron pixels

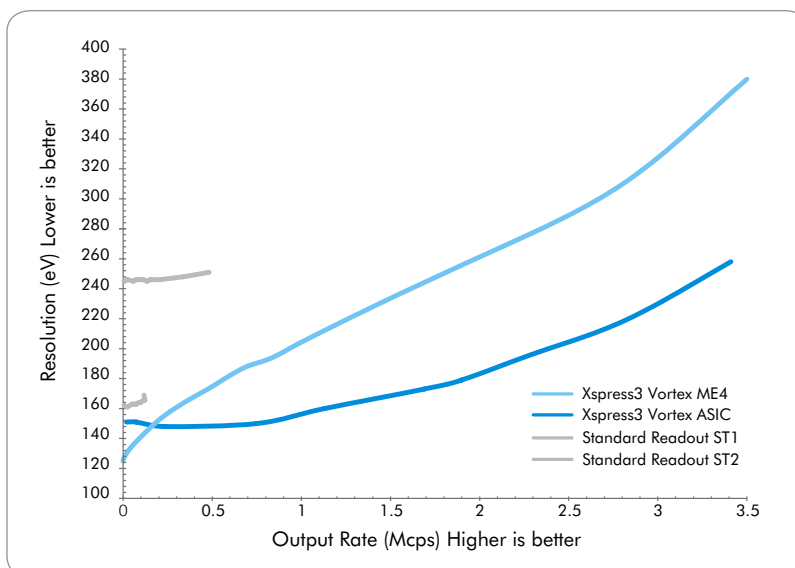
Resolution

While Xspress 3 offers higher resolution than the competition at rates above 100 kcps, it has also been proven to have as good resolution at low rates as other readout systems. Tests at the APS showed that at 35 kcps, the energy resolution of the system was 127 eV, at Mn K α using the NIST SRM1832 standard fluorescence spectroscopy sample.

The following Xspress 3 data were recorded at GSECARS on the ID-13-E beamline at the APS. While this is a more unusual way of visualizing measures of readout performance, it emphasizes the difference between the adaptive filtering technology used in Xspress 3 and standard shaping time systems.

Standard readout systems have fixed shaping times and as such, the resolution is broadly fixed as rate increases until saturation and subsequent paralysis of the readout system. Data from such a readout system is plotted to aid comparison.

Xspress 3 operates at the optimum compromise between rate and resolution at all rates. This means that you see either improved resolution or rate performance or both and with no change of settings required for each sample, point or pixel.



Xspress 3 comparison with standard readout system at 2 shaping times

Xspress 3 ME4 Results taken at ID-13-E from a single channel of Vortex ME4 used on Xspress 3. Mn K peak fitted from NIST SRM1832 standard fluorescence spectroscopy sample. Comprehensive details available on request.

Xspress 3 ASIC results taken with Vortex EM ASIC at B16 at Diamond.

Standard readout data taken at Diamond by experienced detector engineers.

Software

Delivering excellent software as part of experimental systems is a vital to their success. We understand this and as such offer industry standard open source EPICS and TANGO drivers with Xspress 3¹. This ensures that our system will integrate seamlessly with all beamlines, offering ease of use and strong support options.

The data that is made available through the server included with any Xspress 3 purchase can be accessed by any remote terminal (Linux, Windows or OSX) and either gathered directly from PVs or the GUI accessed through SSH.

A number of data analysis packages have been developed or adapted by the community to enable more efficient analysis of Xspress 3 data such as Larch from GSECARS at the APS, Dawn from Diamond Light Source and Mapping Software at Stanford. Ongoing work is taking place with other packages.

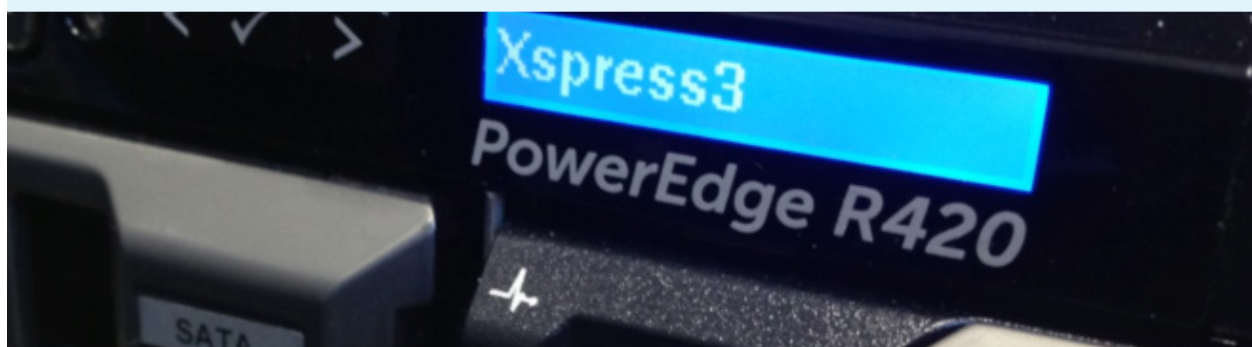
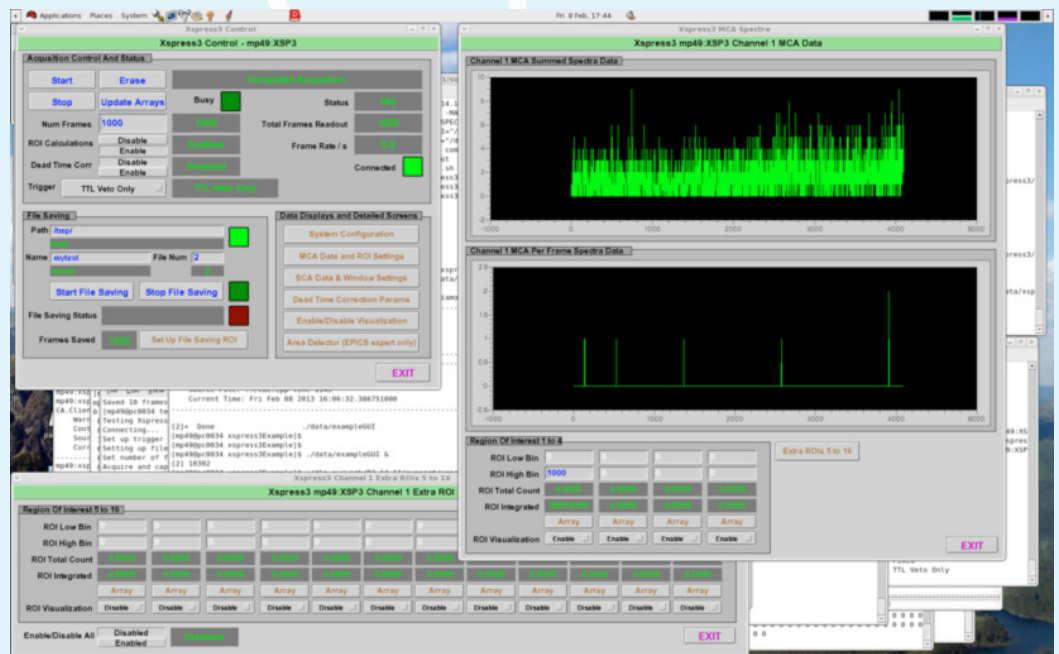
The 6 core Dell server provided comes with redundant power supplies, hot swappable 1TB RAID 0 drives, a 10GB fibre and gigabit ethernet connections to Xspress 3 and the web.



¹ The open source EPICS drivers for Xspress 3 can be found at: controls.diamond.ac.uk/downloads/support/xspress3 and also on GitHub: <https://github.com/NicholasRees/xspress3>

Matt Newville's mapping software can be found at: <https://github.com/newville/xspress3>

For further details about SSRL please get in touch.





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Performance

Maximum Output Rate	>3.5 Mcps
Deadtime / event	>80ns
Maximum Time Frames	4096/channel expandable
ADC bit depth	16
Sample rate	80Mhz / 12.5ns
TTL Channels	4 In and 4 Out
Time between frames	<1 μ s
Max number of time frames	<30,000
Maximum Frame Rate	1MHz

Compatibility

Calibration Routine	Onsite QD Staff with beam/source
Routine Re-Calibration	Unnecessary
Channel Count	1 – 8
Performance Tested	Vortex, Ketek, Canberra HPGe, SGX Sensortech, PN Sensor, Bruker
Input Range	Factory Set
Differential Signal	Compatible
Software Infrastructure	EPICS full support, GDA full support, TANGO full support

Data format

Points per MCA	4096
ROIs	10
Windows (sub MCAs)	2
ROIs, Scalars, MCAs available directly	EPICS and TANGO
File Format from EPICS	HDF5, Accessible during frame write. Watch the map in realtime.

References

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